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HORIZONTAL HYDRAULIC VALVE LIFTER

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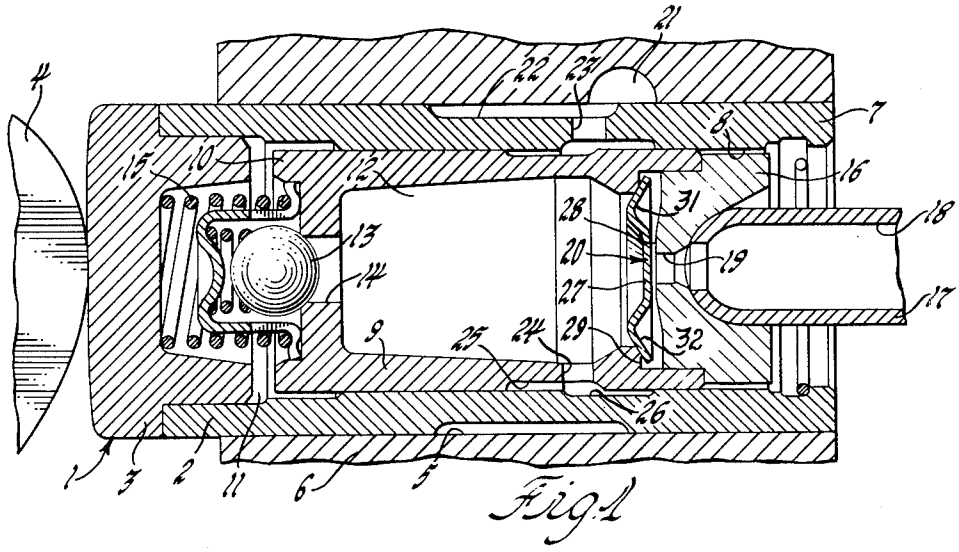


Fig. 1

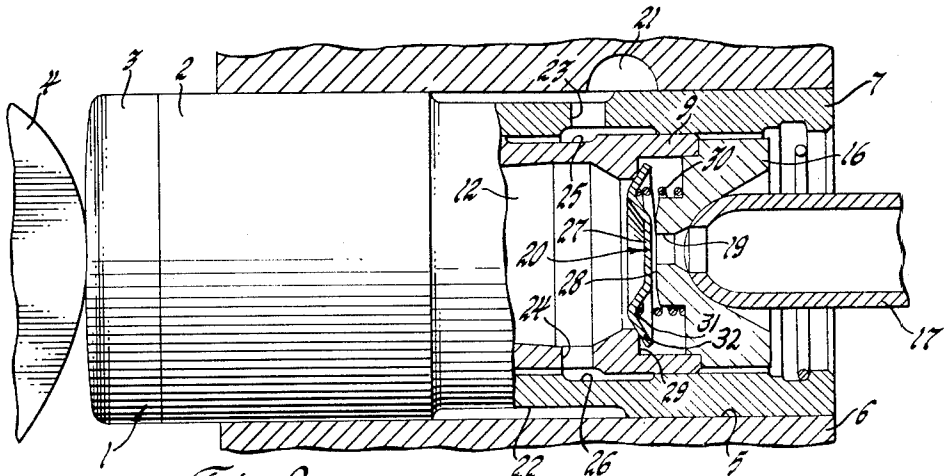


Fig. 2

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HORIZONTAL HYDRAULIC VALVE LIFTER

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This invention relates to externally fed hydraulic valve lifters and the like in the form of a dash pot device wherein the plunger is hollow and serves as a reservoir chamber for the externally fed fluid, and particularly to such devices which operate in a generally horizontal direction.

In operation of such hydraulic valve lifters, once the reservoir chamber and the pressure chamber or dash pot below the plunger is filled with hydraulic fluid (usually oil from the engine pressure lubricating system), any loss of fluid is more than made up to keep the reservoir chamber filled so that it, in turn, can replenish the necessary "leakdown" or escape of fluid from the pressure chamber past the plunger. At the end of each operating cycle (comprising one lift stroke, followed by return of the plunger cylinder to its initial position), such elongation of the lifter as is then necessary to take up all endwise clearance or lash in the valve operating linkage takes place in preparation for the next lift stroke. This hydraulic take-up occurs relatively slowly in comparison to the speed with which the parts move during the lift stroke, hence the noise which would attend the taking up of such lash during the lift stroke is eliminated. However, during an engine shutdown when the oil supply pressure to the lifter is cut off it frequently happens that the oil in the reservoir chamber leaks out and is replaced by air, and during restarting of the engine the lifter is unable to function quietly until this air has been purged from the various chambers and passages within the lifter to enable it to again take up the lash before each lift stroke.

The problem of "leak out" of oil from the reservoir chamber during engine shutdowns is particularly aggravated in the case of such lifters which have a second outlet from the reservoir chamber through which oil is conducted to another part of the engine, such as via the valve operating push rod to lubricate the rocker which transmits the lift motion finally to the engine valve or other part to be actuated by the lifter. During an engine shutdown such an outlet from the reservoir chamber acts in conjunction with the lifter inlet or feed port to vent the reservoir chamber.

Various proposals for solving this problem appear in the prior art. Thus in the U.S. Patent 2,938,508 to Papenguth, a dam or baffling means in the reservoir is provided to positively prevent drainage of oil during an engine shutdown. Similarly in Howson Patent 2,962,012, a check valve positively closes off the reservoir against reverse flow to both the normal inlet feed port and the outlet via the push rod. In the U.S. patent application S.N. 121,020 of Pechenik filed June 30, 1961, now Patent No. 3,053,239 an inwardly opening check valve means is provided in the reservoir at the normal inlet feed port or ports to prevent venting of the reservoir as would otherwise allow drainage of the oil through the outlet to the push rod.

I have found that the desired result can be accomplished in a simpler manner, and without the addition of any parts to the valve lifter, by limiting the normal inlet feed passage to a single side port in the plunger and arranging the flow control valve opposite the aforementioned outlet to serve dually as a check valve closable inwardly of the reservoir. Thus during an engine shutdown, venting of the reservoir via this outlet is blocked by the flow

control-check valve, and no substantial drainage of oil will occur through the single inlet port.

The invention will be more clearly understood from the following description of the structure illustrated in the attached drawing, wherein:

FIGURE 1 is a fragmentary sectional view through the valve lifter guide bore of an internal combustion engine, showing my improved valve lifter installed in operative relation between the usual driving cam and the driven push rod.

FIGURE 2 is a like view of a slightly modified form of the invention wherein the flow control-check valve is biased to its check valve closed position by a light spring.

Referring now in detail to the drawing, and first to FIGURE 1 therein, a hydraulic valve lifter is designated generally by the numeral **1** and includes a rather conventional, generally cup-shaped dash pot or cylinder member formed of a tbue **2** closed at one end by a foot piece **3**. Shown also is the conventional engine driven cam **4** operatively engaging the foot piece **3**. The outer periphery of the tube is slidably guided in the lifter bore **5** of the engine crank case or other fixed part **6** of the engine. The cylinder member **2, 3** is open at its opposite end **7**, and slidably fitting the bore **8** of the tube **2** is a generally cup-shaped member or hollow plunger **9**. The two cup-shaped members **2, 3** and **9** are thus slidably interfitted in nesting relation, with the end wall **10** of the plunger and the cylinder end wall or foot piece **3** forming between them a dash pot or pressure chamber **11**. The internal side walls and end wall **10** of the plunger define a reservoir chamber **12** for storage of fluid (engine oil) required to replenish the pressure chamber **11** for that which escapes therefrom by leakage past the plunger in operation. Means providing a connection between these two chambers for accommodating fluid flow from the reservoir chamber into the pressure chamber, while restricting fluid flow therebetween in the opposite direction, is illustrated in the form of a ball check valve **13** controlling the passage **14** in the end wall of the plunger. Fluid may thus be trapped in the pressure chamber for transmitting thrust from the lifter cylinder to the plunger **9** when movement of the lifter cylinder is effected by the cam **4**. The plunger return spring **15** acts in compression to bias the plunger outwardly of the lifter cylinder at all times, thereby tending to maintain the pressure chamber volume at a maximum at all times. Mounted on the open end of the plunger is a conventional push rod seat member **16** for a push rod **17** which transmits the cam induced plunger motion to the engine valve (not shown) or other engine part to be actuated by the cam.

In the particular construction shown, the push rod is made hollow so that the interior surfaces thereof form a passage **18** for conducting oil from the lifter reservoir **12** to lubricate the valve rocker mechanism (not shown) which is actuated by the push rod. An outlet **19** in the form of a central axial opening through the push rod seat **16** is provided to accommodate flow of oil from the reservoir **12** to the interior of the push rod, and a combined flow control and check valve **20** is arranged within the reservoir **12** opposite this outlet **19**. Suitable external fluid supply means for the lifter is provided including a gallery **21** which may be connected to the engine lubricating pump (not shown), this gallery being open to the lifter bore **5** in the engine. An external annular groove **22** around the lifter cylinder is of sufficient width to communicate at all times with the gallery **21** throughout the reciprocatory stroke of the lifter in the bore **5**, and one or more side ports **23** is provided in the lifter cylinder to connect with the groove **22**. Registering passage means is also provided for connecting the reservoir chamber **12** with the cylinder port or ports **23**, consisting of a single

side port 24 in the plunger and groove means connecting the plunger port 24 and the cylinder port or ports 23. As shown, this groove means is in the form of an external groove 25 around the plunger and an overlapping internal groove 26 around the inner wall of the cylinder member. Insofar as the present invention is concerned it will be appreciated that other porting and grooving arrangements may be used to provide oil feed to the lifter reservoir 12 from the exterior of the lifter, it being important only that the reservoir 12 connect with such external supply via but a single port in the plunger.

Referring again to the combined flow control and check valve 20, this may be formed as an imperforate stamping having a plate-like central portion 27 large enough to overlie the outlet port 19 so as to abut the push rod seat surface 28. An internal shoulder 29 is provided on the plunger below the push rod seat 16 and serves as a closing seat for the valve 20, when in its position shown, to prevent venting of the reservoir 12 via the outlet 19 to the push rod as is apparent from the drawing. Surrounding its central portion 27, the valve 20 has an annularly dished section 31 terminating radially outwardly with a frustoconical rim 32 facing the plunger shoulder 29. By reason of its shape, the rim 31 operates to center the valve 20 in seating on the shoulder 29 and to form a substantially leak-proof seal therewith. This valve has a certain amount of freedom of movement between the closing seat shoulder 29 and abutment with the push rod seat surface 28. When in abutment with the push rod seat surface 28, it is desired (as in the U.S. patent to Papenguth, 2,818,-050) that flow of oil from the reservoir 12 via the outlet 19 be only partially restricted, rather than completely blocked. In the instant construction, such partial restriction only is insured by forming the surface 28 of the push rod seat with a slight cylindrical (single axis curvature) shape, and forming the central portion 27 of the valve 20 substantially flat. Thus with the valve 20 in abutment with the push rod seat, a desired degree of oil flow between the push rod seat surface 28 and the opposing surface of the valve portion 27 is accommodated. A greater degree or rate of oil flow from the reservoir 12 via the outlet 19 may occur, of course, when the valve 20 is in an intermediate position between abutment with the surface 28 and closure seating on the shoulder 29, and its freedom for movement therebetween serves to prevent clogging of the normal restricted flow in effect when it is abutting the surface 28.

During operation, the cam 4 rotates when the engine is running, and the valve lifter functions in conventional manner to transmit the cam motion to the push rod 17 while eliminating substantially all endwise clearance or "lash" therebetween. During such times engine oil under pressure in the gallery 21 is conducted via the grooves 22, 26 and 25 and ports 23 and 24 to the reservoir 12, from whence a metered amount of such oil is permitted to flow past the combined flow control and check valve 20 and through the port 19 into the push rod 17. During an engine shutdown, when all such oil flow ceases, it is important to maintain an ample supply of oil in the reservoir 12 in preparation for restarting the engine so that air is not introduced into the pressure chamber 11 via the ball check 13. Otherwise objectionable noisy operation of the lifter results, as well as its possible damage from lack of sufficient oil cushioning of the plunger in the pressure chamber 11. Such leak-out of oil from the reservoir 12 is prevented, even though the plunger port 24 may be in its lowermost position in the lifter cylinder, by the check valve action of the valve 20 in seating on the plunger shoulder 29. Such closing action of the valve 20 occurs as the result of the pressure head of oil acting against it in the hollow push rod 17 at engine shut-down, and it prevents the reservoir being vented either via the push rod seat port 19 or via any air leakage path existing between the push rod seat 16 and the plunger, with the result that air cannot enter the reservoir to permit displacement of the oil therefrom via the single plunger port 24. A slight depression (sub-atmospheric pressure condition) will thereafter immediately occur within the reservoir in response to any tendency of the oil therein to leak out the plunger port 24 while the valve 20 is seated on the shoulder 29, tending to retain the valve thus seated.

In those applications of my invention where it is found necessary to positively ensure such initial seating of the valve 20, a light biasing spring 30 may be inserted between the valve 20 and the push rod seat 16 as shown in FIGURE 2.

While only two preferred embodiments of the invention have been disclosed it is appreciated that numerous minor changes in the construction and arrangement of the parts may be made without departing from the spirit and scope of the invention as hereinafter claimed.

I claim:

1. In a hydraulic valve lifter having generally cup-shaped cylinder and plunger members in slidably interfitted nested relation forming a fluid pressure chamber between their respective end walls and a reservoir chamber within the plunger member, passage means interconnecting said chambers including means operative to restrict fluid flow from the pressure chamber to the reservoir chamber relative to flow therebetween in opposite direction, said plunger member having a seat member mounted on its open end, said seat member having an opening therein for flow of fluid outwardly of the lifter from said reservoir chamber, a side port in said cylinder member and registering passage means for introducing fluid to the reservoir chamber from the exterior of the lifter, said registering passage means consisting of a single port in the side of the plunger member and groove means connecting said ports, a shoulder on said plunger member providing a check valve seat between said port and said seat member, said seat facing outwardly of the reservoir, and an imperforate check valve closable against said seat.

2. The invention of claim 1, wherein said check valve is limited in its opening movement by abutment with said seat member.

3. The invention of claim 1, wherein said check valve has a generally plate-like surface facing said seat member and said seat member has an opposing surface surrounding said opening, said check valve being limited in its opening movement by abutment of said plate-like surface with said seat surface, one of said surfaces having a substantial single axis curvature relative to the other to ensure against total closure of said opening when said surfaces are in abutment.

4. The invention of claim 3, together with a spring biasing the check valve against said shoulder.

5. In a hydraulic valve lifter having generally cup-shaped cylinder and plunger members in slidably interfitted nested relation forming a fluid pressure chamber between their respective end walls and a reservoir chamber within the plunger member, passage means interconnecting said chambers including means operative to restrict fluid flow from the pressure chamber to the reservoir chamber relative to flow therebetween in opposite direction, said plunger member having a seat member mounted on its open end, said seat member having an opening therein for flow of fluid outwardly of the lifter from said reservoir chamber, a side port in said cylinder member and registering passage means for introducing fluid to the reservoir chamber from the exterior of the lifter, said registering passage means consisting of a single port in the side of the plunger member and groove means connecting said ports, said plunger member having an internal shoulder facing and spaced from said seat member, said shoulder being located outwardly of the reservoir chamber from said port in the plunger member, and a combined flow control and check valve shiftable axially within the plunger member into alternate abutment with said shoulder and seat member, said valve being imperforate and consisting of a generally plate-like central portion

adapted to overextend the lateral extremities of said opening when in abutment with said seat member and having a frusto-conical rim adapted to sealingly engage said shoulder when in abutment therewith, one of said valve central portion and the co-abuttable surface of said seat member having a single axis curvature relative to the other to insure against total closure of said opening when said valve is in abutment with said seat member.

6. The invention of claim 5, wherein said valve rim constitutes the radially outer wall of an annularly dished section surrounding said plate-like central portion, the said central portion being substantially flat and said co-

abuttable surface of the push rod seat being of part cylindrical curvature in convex relation to said valve central portion.

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